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Powder compaction simulation

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ABSTRACT

Powders are one of most manipulated materials in many industries such as food, pharmaceutical, energy and metallurgical industries. An important process for the powders is the compaction into solids with small porosity or high relative density. However, powders exhibit complex behavior during this process. After rearrangement and jamming of the powder bed, many types of deformation mechanisms dominate the compaction of granular materials, including elastic and plastic deformation of each individual particle. Therefore, having a better understanding of macroscale and microscale properties of powder beds and single particles during the compaction process is necessary. In addition, to reduce cost and time for experimental efforts, it is important to have modeling and simulation capabilities for the powder compaction process. This study creates a new version of an existing powder compaction simulation nanoHUB tool. This version includes more features, such as single elastic and plastic particle deformation and microstructure evolution during the compaction of plastic powder beds. Using the solver developed by Dr. Marcial Gonzalez [1, 2], this nanoHUB tool is able to simulate binary mixtures of monodispersed systems of both plastic and elastic particles. Also, it generates the pressure-deformation relationship for a single particle when it is compressed between rigid plates.

[1] Gonzalez M. and Cuitiño, A.M., “A nonlocal contact formulation for confined granular systems”, Journal of the Mechanics and Physics of Solids, 60, 333–350, 2012.

[2] Gonzalez M. and Cuitiño A.M., “Microstructure evolution of compressible granular systems under large deformations”, Journal of the Mechanics and Physics of Solids, under review, 2015.

KEYWORDS

Powder compaction, simulation, plastic deformation, elastic deformation, high relative densities.